

CLAIMS

What is claimed is:

1. A multi-wafer robotic hand, comprising:
a plurality of end effectors, each of said end effectors including:
5 a blade, and
at least one wafer-engaging pad disposed on said each blade;
the at least one wafer-engaging pad structured to releasably grasp a wafer
adjacent a peripheral edge thereof.
- 10 2. The hand of claim 1 wherein said wafer-engaging pad is structured
to retain a grasped wafer during multi-planar movement of the hand.
3. The hand of claim 1 wherein each blade has disposed thereon at least
one wafer rest pad configured to support a wafer adjacent a peripheral edge thereof.
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4. The hand of claim 3 wherein said rest pad is disposed adjacent a
proximal end of said blade.
5. The hand of claim 1 wherein said wafer-engaging pad is disposed
20 adjacent a distal end of said blade.
6. The hand of claim 1 wherein the hand further includes a wafer
sensor.
- 25 7. The hand of claim 6 wherein the wafer sensor is operative to sense a
wafer adjacent a blade.
8. The hand of claim 6 wherein the wafer sensor is an optical wafer
sensor.
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9. The hand of claim 1, further comprising a body defining an inner cavity housing proximal ends of the plurality of blades.

10. The hand of claim 9 wherein the body includes a plurality of sub-bodies, each sub-body corresponding to a blade.

11. The hand of claim 10 wherein the body includes an air exhauster operative to exhaust air from a sub-body via an air exhaust port communicating with the sub-body.

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12. The hand of claim 9 wherein the body is structured to permit negative air flow therethrough.

13. The hand of claim 9 wherein the air exhauster includes an air exhaust manifold.

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14. The hand of claim 13 wherein the air exhaust manifold is structured to flow air out of the body via a plurality of air exhaust ports communicating with the body.

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15. The hand of claim 1 wherein the plurality of blades are configured to have a pitch suitable for interdigitation with a plurality of wafers in a multi-wafer receptacle.

16. The hand of claim 15 wherein the pitch between the plurality of blades is at least about 5 mm.

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17. The hand of claim 15 wherein the pitch between the plurality of blades is 10 mm.

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18. The hand of claim 15, further comprising a spacer between any two adjacent blades of the plurality of blades, the spacer producing a pitch therebetween.

5 19. The hand of claim 18 wherein the spacer is changeable.

20. The hand of claim 1 wherein end effectors are structured to securely retain a plurality of grasped wafers during multi-axial movement of the hand.

10 21. The hand of claim 1 wherein each effector is structured to uniformly position a geographic center of an engaged wafer relative to an engaging blade.

22. The hand of claim 21 wherein each end effectors further comprises a second wafer rest pad, said first and second wafer rest pads disposed on the distal
15 end of the blade.

23. A robot having a hand structured to grasp and move a plurality of wafers simultaneously, comprising:

a movable arm;

20 a wrist rotatably mounted on one end of said arm; and

a robotic hand having a plurality of end effectors, each of said end effectors including:

a blade, and

at least one wafer-engaging pad disposed on said each blade;

25 the at least one wafer-engaging pad structured to releasably grasp a wafer adjacent a peripheral edge thereof.

24. The robot of claim 23 wherein said hand is structured to retain one or more grasped wafers during multi-planar movement.

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25. The robot of claim 23 wherein the hand has at least one wafer rest pad disposed on a blade thereof and configured to support a wafer adjacent a peripheral edge thereof.

5 26. The robot of claim 24, further comprising a wafer sensor.

27. The robot of claim 26 wherein the wafer sensor is operative to sense a wafer adjacent a blade.

10 28. The robot of claim 23 wherein the hand is structured to permit air flow through a cavity thereof.

29. The robot of claim 28, further comprising an air exhauster operative to exhaust air via an air exhaust port communicating with the cavity.

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30. The robot of claim 29 wherein an air exhaust manifold is structured to permit air flow out of the body via a plurality of air exhaust ports communicating with the cavity.

20 31. The robot of claim 23 wherein the plurality of end effectors are configured to have a pitch suitable for interdigitation with a plurality of wafers in a multi-wafer receptacle.

25 32. The robot of claim 31 wherein the pitch between the plurality of end effectors is at least about 5 mm.

33. The robot of claim 31 wherein the pitch between the plurality of end effectors is 10 mm.

34. The robot of claim 31, further comprising a spacer between any two adjacent end effectors of the plurality of end effectors, the spacer producing a pitch therebetween.

5 35. The robot of claim 34 wherein the spacer is changeable.

36. A method for moving a plurality of wafers, comprising:
positioning a plurality of blades of a robotic hand adjacent an opening of a first wafer receptacle having a plurality of wafers arrayed therein;
10 inserting the hand into the first wafer receptacle;
mechanically grasping a selected number of wafers by a corresponding number of blades;
withdrawing the hand from the first wafer receptacle;
positioning the hand adjacent an opening of a second wafer receptacle;
15 inserting the hand into the second wafer receptacle; and
releasing the selected number of wafers into the second wafer receptacle.

37. The method of claim 36 wherein the selected number of wafers is one of one, two, three, four, or five wafers.

20 38. The method of claim 36, further comprising sensing the presence of the selected number of wafers in the first wafer receptacle.

39. The method of claim 38 wherein sensing the presence and position
25 of the plurality of wafers comprises sensing a wafer peripheral zone proximate the hand.

40. The method of claim 39 wherein sensing of wafer comprises
detecting a displacement of a wafer contact pad when said wafer contact pad
30 contacts a wafer peripheral zone.

41. The method of claim 39 wherein optically sensing the wafer comprises optically detecting a displacement of a wafer contact pad when said wafer contact pad contacts a wafer peripheral zone.

5 42. The method of claim 38 wherein sensing the presence and position of the plurality of wafers comprises optically sensing a wafer peripheral zone proximate the hand.

43. The method of claim 36 wherein mechanically grasping a selected
10 number of wafers comprises mechanically grasping each wafer only at a peripheral zone thereof.

44. The method of claim 36 wherein releasing the selected number of wafers comprises arraying the wafers in the second wafer receptacle.

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